Elucidating rhizosphere processes in a short rotation forestry field experiment in a former Uranium mining area

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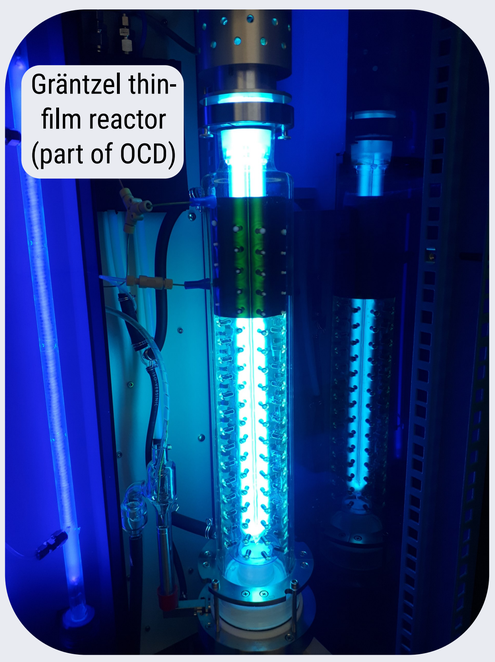
- **Aims:** develop microbially **controlled phytostabilization** measures with **mycorrhizal fungi** for site-independent concepts
- **Overarching objectives:** erosion and trace metal discharge reduction, and improvement of water availability for host trees for **long-term restoration** of post-mining landscapes

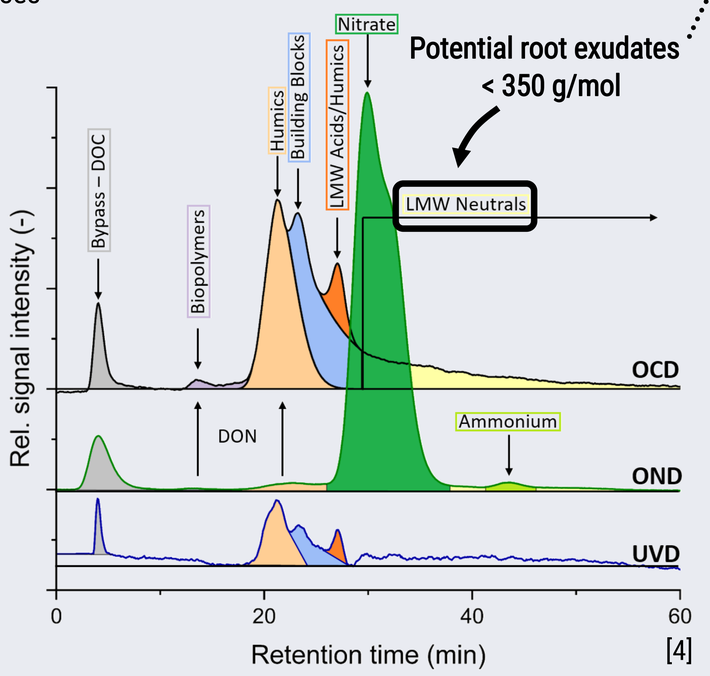
Research area

- The test site „Gessenwiese“ was established in a **former Uranium mining** area in Ronneburg, Thuringia, Germany [1]
- The site is influenced by **acid mine drainage** (AMD) and moderately contaminated with **trace metals** and **natural radionuclides** [1]
- On site, **bioremediation** strategies (addition of **calcareous** substrate - **Rendzina**, inoculation with **mycorrhiza** and ***Streptomyces***) are combined with **biomass** production using short rotation forestry with **birch**, **alder** and **willow** trees [2]

Objective & method

- Explore the use of **Liquid Chromatography—Organic Carbon/Nitrogen Detection [3] (LC-OCD-OND)** as a tool to understand **mycorrhizosphere** processes

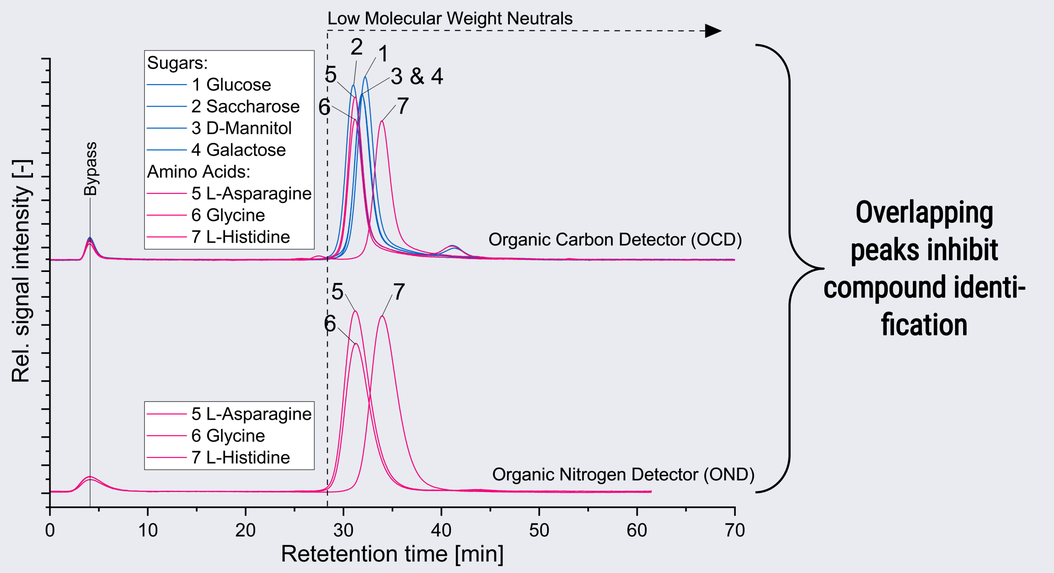




DOC/DON—Dissolved Organic C/N
UVD—UV-Detector
OCD—Organic Carbon Detector
LMW—Low Molecular Weight
OND—Organic Nitrogen Detector

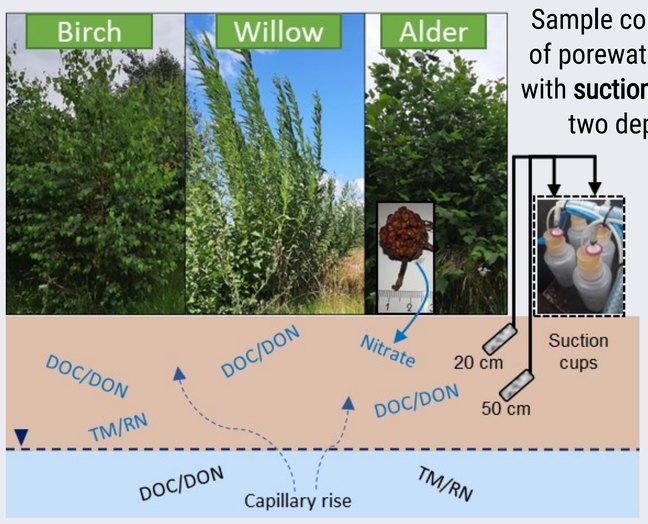
How can we identify these potential root exudates?

1) Creation of a **lab-internal database** using standards and comparison of retention times and C/N ratios



2) Combining LC-OCD-OND (i.e. fraction collection) with **High-Resolution Mass Spectrometry** } **Outlook**

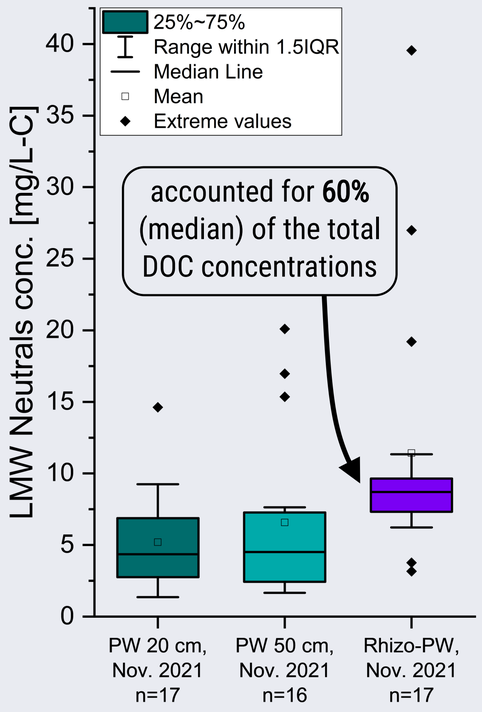
Sampling



TM—Trace metals
RN—Radionuclides

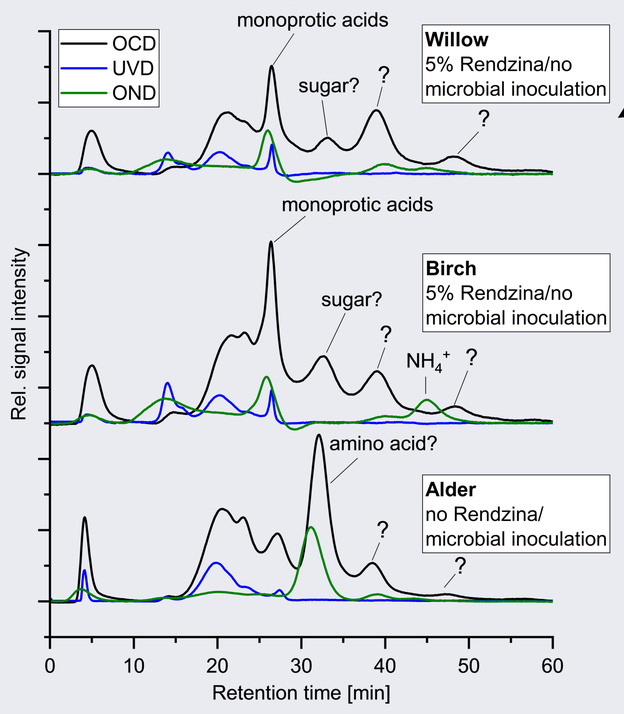
Sample collection of porewater with **mini suction cups** directly in the rhizosphere

Results

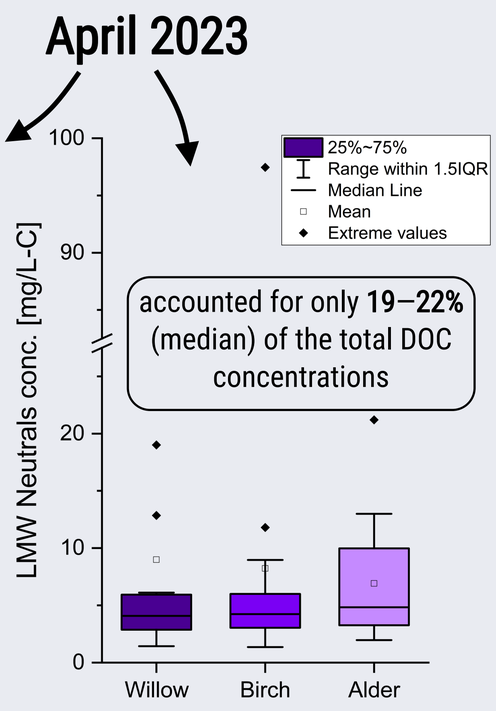


Root exudation can be measured with **LC-OCD-OND.**

Exemplary chromatograms:



Further analyses necessary for compound identification.



No concentratoion difference between the **tree species** found.

Key messages

- **LC-OCD-OND** is a **promising tool** for…
  - the **quick analysis** of the **DOC concentration** and size-related **rhizosphere compound characterization**
  - the evaluation of the **presence of root exudates** even if **specific compound identification** (i.e. sugars) **remains challenging**
- **Outlook: Combining** LC-OCD-OND with High-Resolution Mass Spectrometry…
  - to potentially reveal **seasonal dynamics on a molecular level**
  - to bring light into **rhizosphere processes** of different **tree species** or **soil amendments** in former mining areas

[1] Grawunder, A., et al. (2009). *Chemie der Erde-Geochemistry* 69, 5-19. DOI 10.1016/j.chemer.2008.06.001.
[2] Büchel, G., et al. (2019). *Friedrich Schiller University Jena.* DOI 10.2314/KXP:1687577951.
[3] Huber, S.A., et al. (2011). *Water research* 45(2), 879-885. DOI 10.1016/j.watres.2010.09.023.
[4] Nettemann, S. (2024). *Friedrich Schiller University Jena.* Soon to be published (Dissertation).

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